

A NEW SPECIES OF *PSALTODA* STÅL, WITH NOTES ON
COMPARATIVE MORPHOLOGY AND SONG STRUCTURE
(HEMIPTERA: CICADIDAE)

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Abstract

Psaltoda brachypennis sp. nov. is described from Queensland and New South Wales. Information on song, habitat, distribution and season is given and its morphology and song structure are compared with three allied species, *P. claripennis* Ashton, *P. harrisii* (Leach) and *P. plaga* (Walker).

Introduction

Moulds (1984) recognised 11 species in the endemic Australian genus *Psaltoda* Stål, provided a key for their identification and documented their distributions. Moulds (1990) also noted certain morphological characteristics of the genus such as 'a distinct silverish pubescent patch laterally on abdominal tergite 3' and the 'upward turning of the male opercula along at least half the length of their lateral margins' as well as noting that their 'songs are complex and have characteristic yodel-like segments, produced by pulsating upward flexings of the abdomen'.

Young (1972) commented that 'the physical characteristics of the free songs of [cicadas in his study] are remarkably varied and distinct from each other. The songs are also distinct to the human ear and are readily picked out in the field. It seems likely, therefore, that a recording and analysis of the songs might be useful in taxonomic work on Australian cicadas.'

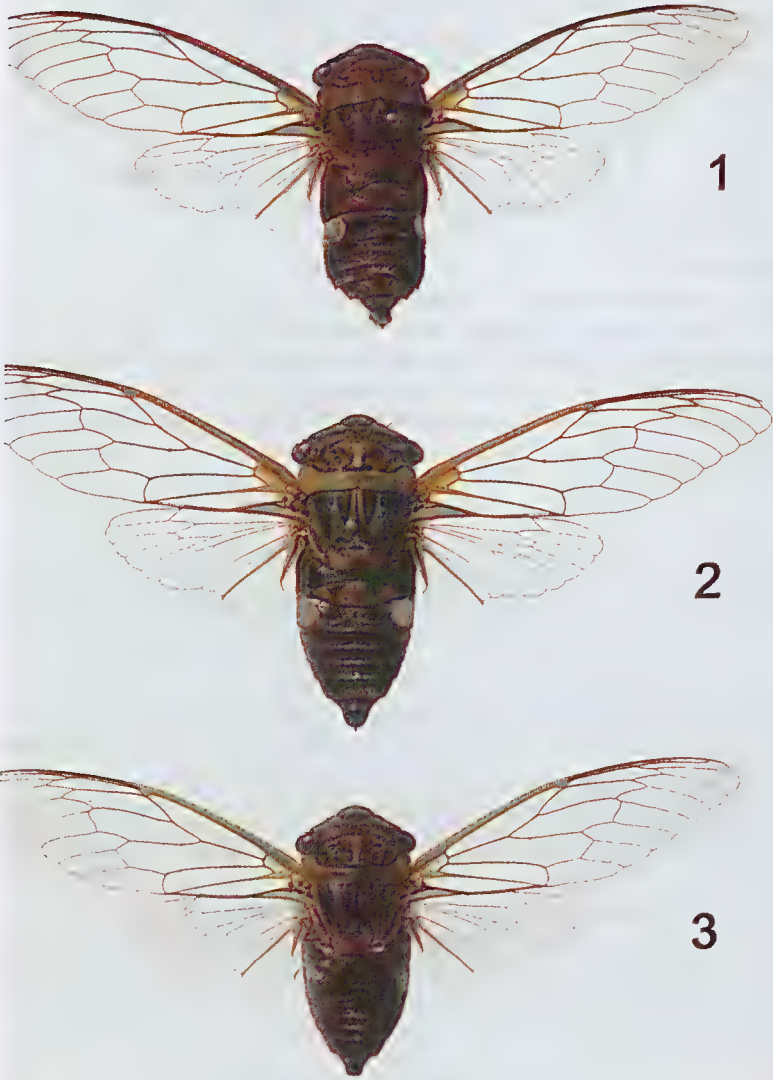
Morphological comparisons made between *P. brachypennis* and three other closely allied species have shown that *P. brachypennis* primarily differs in fore wing and head shape, the positions of opercula relative to metasternum and to some extent in colour and abdominal pubescence. The song of *P. brachypennis* differs from its close allies in structure and component frequencies.

Collections are abbreviated as follows: AE - A. Ewart, Caloundra, Qld; MC - M. Coombs, Brisbane; TL - T. Lambkin, Brisbane; LWP - L.W. Pople, Brisbane; JTM - J.T.St.L. Moss, Brisbane; MSM - M.S. Moulds, Sydney; QM - Queensland Museum, Brisbane; UQIC - University of Queensland, Brisbane.

***Psaltoda brachypennis* sp. nov.**

(Figs 1, 4, 7-9)

Types. *Holotype* ♂, Gunalda Ra., 25km NW Gympie, Qld, dry vine scrub, 8.ii.1992, J.T. Moss; Queensland Museum reg. no. T62989 (QM). *Paratypes.* QUEENSLAND: 1 ♂, 2 ♀♀, Bulburin State Forest, Central Qld, 29-30. xii. 1993, A. Ewart; 1 ♂, 'The



Figs 1-3. Males: (1) *P. brachypennis*; (2) *P. plaga*; (3) *P. claripennis*. Approximately 1.6x life size.



Figs 4-6. Females: (4) *P. brachypennis*; (5) *P. plaga*; (6) *P. claripennis*. Approximately 1.6x life size.

Amphitheatre', NW of Robinson Gorge NP, 25°12'07"S, 148°59'43"E, open forest, 17.xii.1997, A. Ewart; 1 ♂ 'The Amphitheatre', NW of Robinson [Gorge] NP, 25°12'07"S, 148°59'25"E, vine scrub, 19.xii.1997, A.Ewart (all AE); 1 ♂, 1 ♀, Mt. Maroon, nr Boonah, 28.xii.1993, M. Coombs (MC); 1 ♂, Mt Coot-tha, via Brisbane, 1.ii.1990, T. Lambkin; 1 ♀, The Gap, Brisbane, 26.xii.1973, T. Lambkin (both TL); 1 ♂, 'Grasree Hill', 5 km N of Monto, 14.xii.1999, L. Popple, J. Moss; 1 ♂, Mt. Marrow via Haigslea, 8.i.2000, L. Popple, J. Moss (both LWP); 1 ♀, Mt. Morgan, 15 km SW Rockhampton, eucalypt forest, 1.i.1973, J.T. Moss; 1 ♀, Bulburin State Forest 391, ca 650 m, 25 km NE Monto via Many Peaks, complex notophyll vine forest, 30.xii.1993, J.T. Moss; 2 ♂♂, Bluff Ra., Biggenden, 65 km W Maryborough, 21.xii.1970, H. Frauca; 1 ♀, Mt. Woowoonga, 664 m, 10 km NE Biggenden, 29-30.i.1972, H. Frauca; 1 ♂, Reservoir Hill, Barnett Rd., Takura, 15 km SW Hervey Bay, remnant dry vine scrub, 2.i.1991, J.T. Moss; 2 ♂♂, 1 ♀, River Heads, 25 km NE Maryborough, vine forest remnant, 26.xii.1990, J.T. Moss; 4 ♂♂, 1 ♀, Gunalda Ra., 25 km NW Gympie, dry vine scrub, 8.ii.1992, J.T. Moss; 5 ♂♂, 1 ♀, Gunalda Ra., 25 km NW Gympie, dry vine scrub, 1.i.1994, J.T. Moss and A. Ewart; 1 ♂, Mt. Marrow via Haigslea, 8.i.2000, J. Moss, L. Popple (all JTM); 1 ♂, Daydream I, [20°15'S, 148°48'E] via Proserpine, 20.ii.1984, R. Eastwood; 1 male, Edungalba nr Duaringa, 22.i.1982, M.S. & B.J. Moulds; 1 ♂, 'Mourangee' Hsd nr Edungalba, softwood scrub, 14.xii.1983, E.E. Adams; 1 ♀, same data but 14.xi.1987; 1 ♂, 2.5 km E of 'Mourangee' Hsd, nr Edungalba, E.E. Adams; 1 ♀, same data but 28.xi.1987; 1 ♂, 4 km N of 'Mourangee' Hsd, nr Edungalba, 23°43'S 149°51'E, 30.i.1987, E.E. Adams (all MSM); 1 ♂, Mt. Cleveland, [19°15'S 147°02'E] 25 km E Townsville, 13.i.1991, A. Graham; 1 ♂, 16 km N Boonah, 27°54'S 152°41'E 3.xii.1997, C.J. Burwell; 1 ♂, Hurdle Gully, 460 m, 24°55'S 150°59'E, 14.8 km WSW of Monto, open forest, M.V. lamp, 19.xii.1997, Burwell, Evans, Ewart; 1 ♀, 'Amphitheatre', 520 m, 25°13'S, 148°59'E, Expedition Ra. N.P., vine scrub, 18.xii.1997, C.J. Burwell, S. Evans; 1 ♀, 'Amphitheatre' campsite, 560 m, 24°54'S 148°59'E, Expedition Ra. N.P., open forest, 18.xii.1997, Burwell, Evans, Ewart; 1 ♀, Black Rock, S of Boonah, vine forest, 4.i.1990, C.J. Burwell; 1 ♀, Perry's Knob, 4 km NE of Rosewood, 200 m, 27°36'S, 152°36'E, vine scrub, 13.i.1999, G. Thompson; 1 ♀, Fletcher (near Stanthorpe), Qld, (no date), E. Sutton (all QM); 1 ♀, Toowoomba, 9.i.1964, J.C. Cardale (UQIC). NEW SOUTH WALES: 1 ♀, Glenugie State Forest, south of Grafton, 19.i.1978, J.T. Moss; 1 ♂, Mt. Kaputar, Nandewar Ra., ca 960 m, 30°12'S 150°5'E, 50 km E Narrabri, open forest, on *Eucalyptus albens*, 7.i.1990, J.T. Moss (both JTM).

Description of Male (Fig. 1)

Head. Vertex olive-green with 0.5 mm wide black line between eyes and ocelli outlined in orange. Postclypeus not prominent, olive-green to yellow-brown with black midline interrupted anteriorly and with approximately nine transverse ridges, finely marked black. Lora covered in fine white pubescence. Anteclypeus brown. Rostrum tan basally, shaft black, almost reaching bases of hind coxae. Antennae black, 0.5-1 mm. Ocelli glassy yellow, within a black fascia. Eyes, in live specimens, brown.

Thorax. Pronotum olive-green, fissures black, median 1 mm wide orange stripe, black outlined laterally and posteriorly, abutting pronotal collar posteriorly, fanning out anteriorly as a wedge into the pronotal disc, covering the middle one third anterior pronotal margin where it is a definite olive-

green in living specimens (rich reddish-brown in dried specimens). Pronotal collar uniformly olive-green. Mesonotum olive-green with two pairs of paramedian black subtriangular fasciae with bases under pronotal collar and apices directed posteriorly, the inner pair outlined in orange, extending one third the length of the mesonotum, the outer pair dissected by irregular greenish brown markings extending close to anterior arms of cruciform elevation. Cruciform elevation uniformly olive-green, paler in dried specimens. A median, black dagger-shaped marking, the shaft between the inner pair of subtriangular fasciae with apex extending anteriorly almost to pronotal collar, and lateral 'deflectors' filling the gap between the anterior arms of the cruciform elevation. Metanotum orange (fading to tan in dried specimens) with posterior and lateral black edging. Thorax below greenish-yellow with copious silvery-white pubescence.

Legs. Coxae and femora shiny yellowish-green. Mid femora with anterodorsal blackish stripe. Fore tibiae and tarsi brownish-black. Proximal half of mid tibiae green, distal portion and tarsi brownish-black. Hind tibiae and tarsi tan.

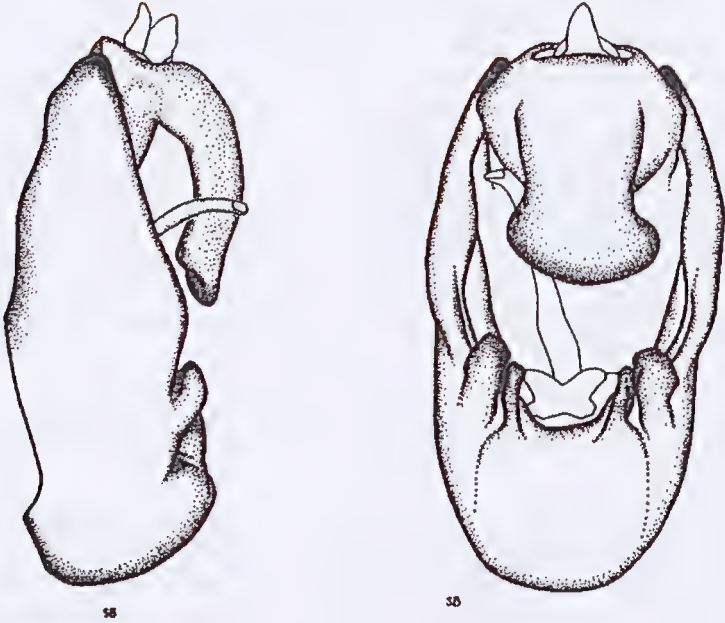
Wings. Hyaline except for slight smokiness of the apical area of both fore and hind wings. No anastomotic (cross-vein) infuscation present. Venation generally reddish-black except for fore wing costa, which is olive-green from base to node. Basal cell olive-green, basal membrane greyish white. Hind wing with narrow brownish-white plaga for length of vein 2A and broader brownish-white plaga for three quarters length of vein 3A.

Opercula (Fig. 9). Somewhat bulbous, uniformly shining greenish-yellow (giving a pseudotranslucent appearance), meeting posteriorly but not overlapping and separated for the most part by the bulbous central projection of the metasternum, and laterally curved upwards with the lateral margins aligned with but largely separated from the lower margins of the tymbal covers.

Abdomen. Tergites generally a rich, dark, reddish-brown with blackish anterior margins and covered with scattered silvery-white pubescence. A large oval patch of silvery-white pubescence laterally on tergite 3. Sternite I obscured by opercula. Sternite II black and III-VII translucent orange-brown. Sternite VIII much paler and opaque. White spiracles are sometimes obscured by shiny white pubescence.

Genitalia (Figs 7, 8). Pygofer black basally, centrally and marginally, with pale orange lateral fascia. Uncus pale brown, broad, with expanded, asymmetrical, rounded, bilateral lobes at apex. Aedeagus smooth, slender, parallel-sided, gently curved.

Female (Fig. 4). Similar to male. Abdominal segment 9 orange with lateral black triangular fascia each side extending for half the length, the base of each fascia hidden under tergite 8. Apical spine black. Sternite II black,



Figs 7-8. *P. brachypennis*, male genitalia: (7) pygofer, left lateral view; (8) pygofer, ventral view.

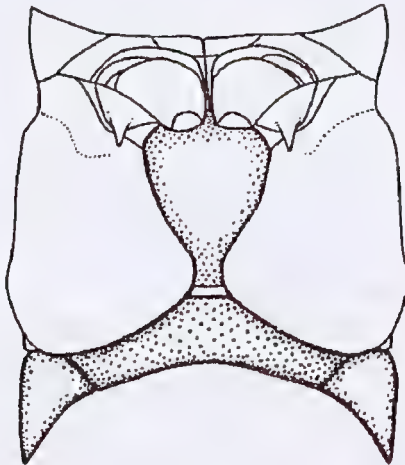


Fig. 9. *P. brachypennis*, opercula and metasternum of male.

remainder tan. Sternite VII with tiny (0.3 mm) brownish-black dot each side. Ovipositor brownish-black.

Dimensions. Range and average for 26 males and 13 females. Length of body: males 27.0-34.0 mm (mean 31.3 mm), females 24.0-30.0 mm (mean 25.6 mm). Length of fore wing: males 34.0-41.0 mm (mean 37.3 mm), females 33.0-38.0 mm (mean 35.7 mm). Width of fore wing: males 12.0-14.0 mm (mean 13.2 mm), females 11.5-14.0 mm (mean 12.6 mm). Width of head: males 12.0-13.0 mm (mean 12.4 mm), females 11.5-12.5 mm (mean 12.0 mm). Width of pronotum: males 11.0-12.0 mm (mean 11.7 mm), females 11.0-12.0 (mean 11.4 mm).

Etymology. The specific name is derived from the Greek *brachys* meaning short and the Latin *penna* meaning a wing or feather.

Morphological comparisons with similar species

Forewing. Length/width ratios for males and females of *P. brachypennis* were compared with those of the three species considered most similar to it, *P. claripennis* Ashton, *P. harrisii* (Leach) and *P. plaga* (Walker). Length measurements were taken from the extreme base of the wing to the apex and width measurements were taken from the costal node to the junction of vein CuA1 with the ambient vein. The results show no significant differences between *P. claripennis*, *P. harrisii* and *P. plaga*, but there is clearly a difference between these and *P. brachypennis*, which is statistically significant (Tables 1 and 2). Note coincident mean for both sexes of *P. brachypennis* and nil overlap between this and allied species (Fig. 10).

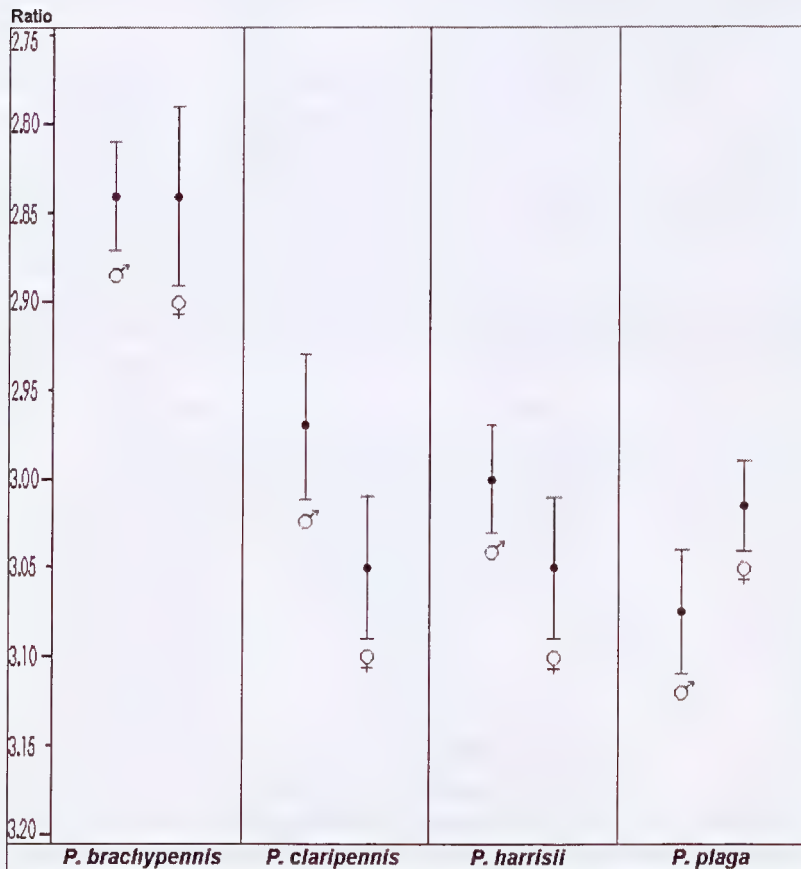
Table 1. Comparative measurements of *P. brachypennis* and three similar species (Length/width ratios of forewings).

Species	Gender	No. of specimens	Mean \pm S.E.
<i>P. brachypennis</i>	♂	26	2.84 \pm 0.029
	♀	13	2.84 \pm 0.047
<i>P. claripennis</i>	♂	10	2.97 \pm 0.038
	♀	10	3.05 \pm 0.041
<i>P. harrisii</i>	♂	10	3.00 \pm 0.028
	♀	10	3.05 \pm 0.040
<i>P. plaga</i>	♂	11	3.08 \pm 0.035
	♀	10	3.02 \pm 0.029

Male underside. The metasternal midline bulge is very prominent in *P. brachypennis* and *P. harrisii*, but less obvious in *P. plaga* and *P. claripennis*. The opercula in the former two species either just meet in ventral midline or there is clear separation. In *P. plaga* and *P. claripennis* there is never any separation, they either overlap or at least clearly meet in midline (Fig. 9).

Table 2. Two-tailed *t*-test results for measurement comparisons. (Critical *p*-value is 0.05).

Comparisons of <i>P. brachypennis</i> with:	Gender	Total degrees of freedom	<i>p</i> -value
<i>P. claripennis</i>	♂	34	0.02
	♀	21	0.004
<i>P. harrisii</i>	♂	34	0.003
	♀	21	0.005
<i>P. plaga</i>	♂	35	0.00004
	♀	21	0.007

**Fig. 10.** Mean wing length/width ratios (\pm standard error) for both sexes of four species of *Psaltoda*.

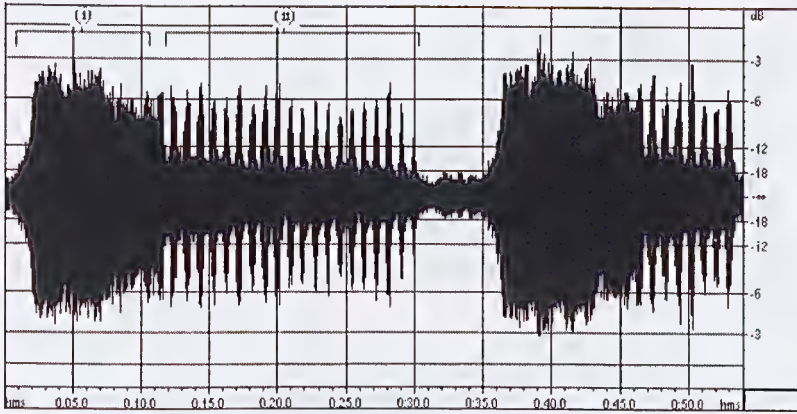


Fig. 11a

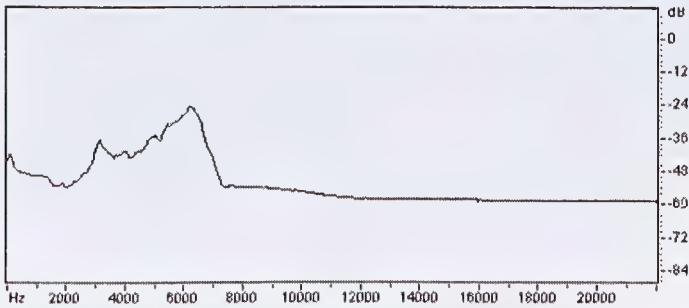


Fig. 11b

Fig. 11. *Psaltoda brachypennis*. (a): Oscillogram of free calling song showing (i) continuous ('roaring') phase and (ii) revving phase. Recorded by J.T.St.L. Moss at Mt. Coot-tha Botanic Gardens, Brisbane on 21. Jan. 1987, with a Marantz Superscope cassette tape recorder and digitized using *Cool Edit 2000* analysis program (Syntrillium software company). (b): Blackmann-Harris linear frequency analysis of Fig. 11a recording.

Wings. In *P. harrisii* and *P. claripennis* the wings are clear. In *P. plaga* they are clear, but with infuscation of the first two apical (anastomotic) cross veins in the fore wing. *P. brachypennis* has no infuscation, but has a slight smokiness of the apical cellular areas of both fore and hind wings. In addition, the basal cells of *P. brachypennis* and *P. plaga* are opaque green, whereas that of *P. claripennis* is translucent green and *P. harrisii* is translucent yellow (Figs 1-6).

Head. Viewed dorsally, *P. harrisii*, *P. claripennis*, and *P. plaga* have an acute-angled head due to prominent postclypeus. *P. brachypennis* is generally more obtuse or blunt (Figs 1-6)

Male abdomen. The lateral aspect of tergite 3 has a patch of shiny silvery-white pubescence in *P. brachypennis*, but is yellow in *P. harrisii*, pale gold in *P. plaga* and silvery-gold in *P. claripennis* (Figs 1-3).

Female abdomen. The truncate appearance of the abdomen of female *P. brachypennis* is very distinctive. The abdomens of female *P. plaga* and *P. claripennis* are more gradually tapered, giving a more 'pointed' appearance (Figs 4-6).

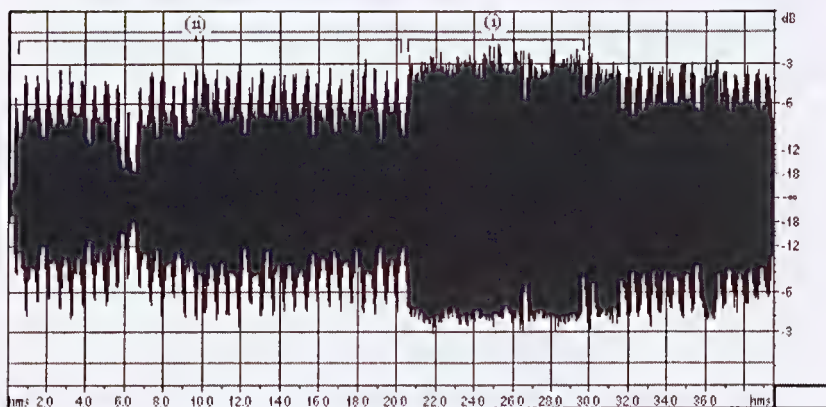


Fig. 12a

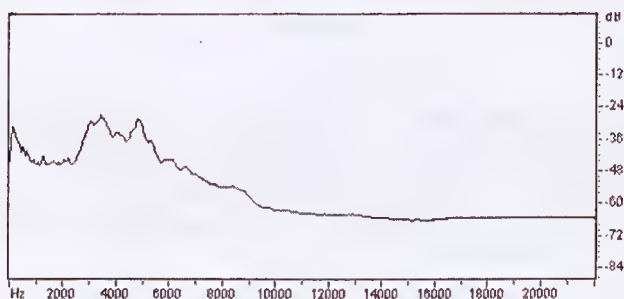


Fig. 12b

Fig. 12. *Psaltoda plaga*. (a): Oscillogram of free calling song showing (i) continuous ('whining') phase and (ii) revving phase. Recorded by J.T.St.L. Moss at Girrahween Park, Earlwood, Sydney, ca 1970, on a Sony reel-to-reel tape recorder and digitized as per Fig. 11a. (b): Blackmann-Harris linear frequency analysis of Fig. 12a recording.

Body colour. *P. brachypennis* in life is a dull olive-green which differs from the much brighter green tones of *P. claripennis* and green individuals of *P. plaga* (Figs 1-6). *P. harrisii* is predominantly brownish-black on a yellowish background (see Moulds 1990 for photo).

Genitalia. The male genitalia do not differ significantly from other *Psaltoda* species. There are only minor differences in the shape of the expanded apex of the uncus.

Song structure of *P. brachypennis*

The calling song of *P. brachypennis* is similar to at least three other sympatric *Psaltoda* species which have both continuous and revving phases. It starts abruptly with a loud continuous 'roaring' phase similar to that of *P. claripennis* and *P. plaga* but somewhat more melodious. The revving phase has short (0.5-0.6 sec.) phrases at 1.0 sec. intervals and these are audibly clearer and less obscured by a softer background continuous

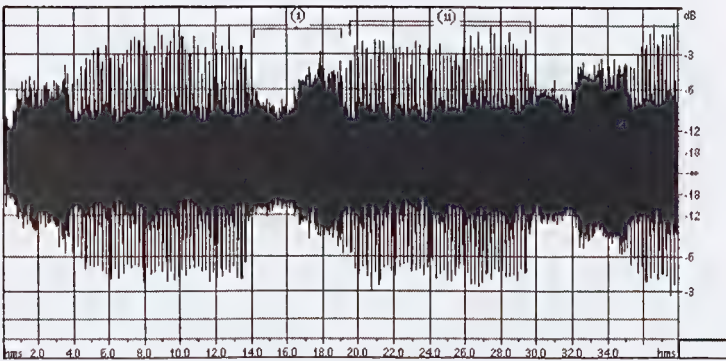


Fig. 13a

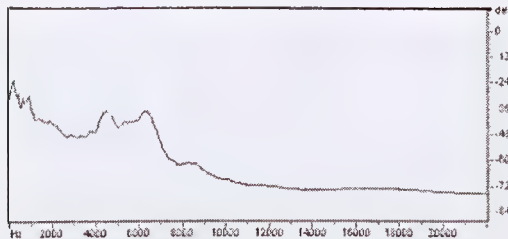


Fig. 13b

Fig. 13. *Psaltoda claripennis*. (a): Oscillogram of free calling song showing (i) continuous ('rattling') phase and (ii) fast revving ('clanging') phase. Recorded by J.T.St.L. Moss at Rockhampton, Qld, in Dec. 1981, on a Sony reel-to-reel tape recorder and digitized as per Fig. 11a. (b): Blackmann-Harris linear frequency analysis of Fig. 13a recording.

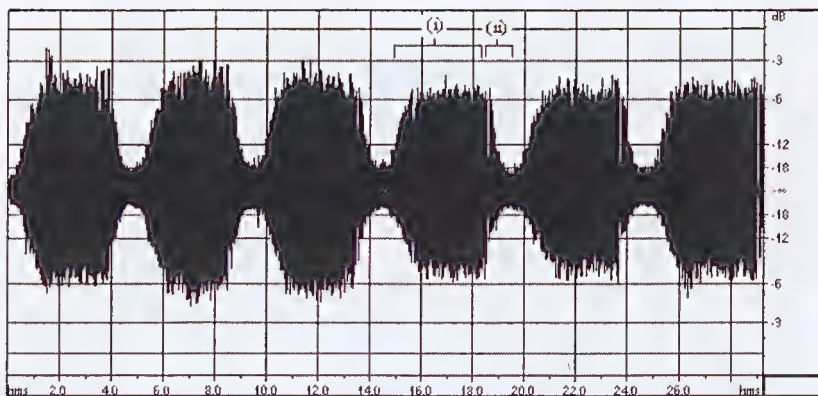


Fig. 14a

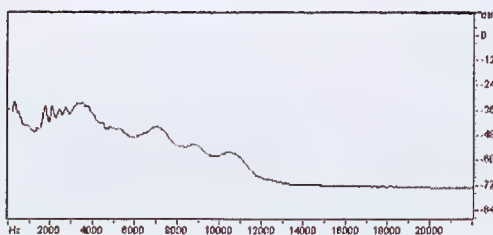


Fig. 14b

Fig. 14. *Psaltoda harrisii*. (a): Oscillogram of free calling song showing (i) initial rising vibrato phase (continuous crescendo) and (ii) abrupt falling phase (fast decrescendo). Recorded by J.T.St.L. Moss at Narrabeen, Sydney, ca 1970, on a Sony reel-to-reel tape recorder. Other details as in above Figures. (b): Blackmann-Harris linear frequency analysis of Fig. 14a recording.

component, which is more a feature of the song of *P. plaga*. The latter species also has 0.5-0.6 sec. phrases, however these are repeated at 0.6 sec. intervals, which produces an audibly 'faster' song than *P. brachypennis*. However, unlike *P. plaga*, revving with *P. brachypennis* does not always occur with each episode of song. On the other hand *P. claripennis* has much shorter individual rev phrases of 0.05 sec. repeated at intervals of 0.2 sec. which produces an even faster song reminiscent of a clanging sound. The song structure of *P. harrisii* is notably different, exhibiting a modified song pattern with an amplitude modulated rising and falling vibrato effect, which can be described as 'rattling' and soft 'sighing'. It lacks a revving phase, but has long crescendo and abrupt decrescendo components (Young, 1972).

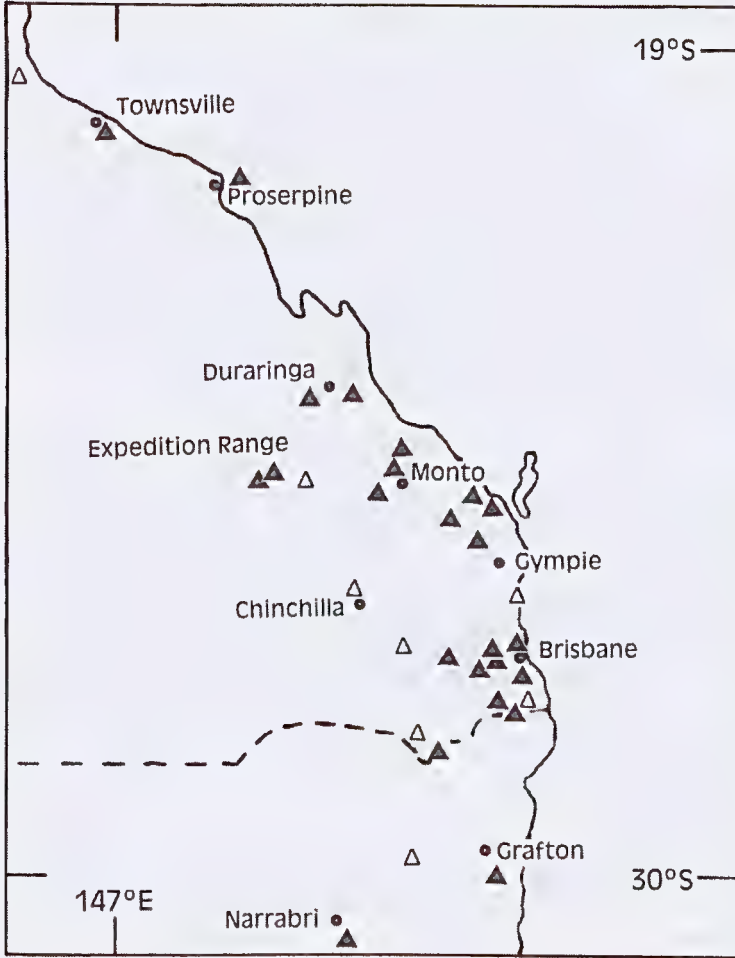


Fig. 15. Distribution of *P. brachypennis*: locations where specimens have been collected (▲); locations of tape recordings and/or aural records which have been confirmed by at least two observers (Δ); geographical reference points (●).

These structural differences can be seen on the oscilloscopic tracings (Figs 11a-14a). The song quality is audibly different, and the frequency analyses show notable harmonic frequency component differences between *P. brachypennis* and its allies (Figs 11b-14b). Young and Josephson (1983) have further analysed both the calling and distress songs of *P. plaga* (as *P. argentata*), *P. claripennis* and *P. harrisii*.

Notes on habitat, distribution and season

The diverse vegetation preference of *P. brachypennis* is most unusual, being found in the following habitats: coastal and montane complex notophyll vine forest (both tropical and subtropical), softwood and dry vine scrubs, and eucalypt dominant dry and wet sclerophyll forests (both montane and coastal). It is usually a mid to late summer species both in the north and south, and along the coast and inland, although in inland central Qld it has been recorded as early as the 14th of November. This is a widespread species, with records along the Queensland coast south from Townsville to Grafton in north-eastern New South Wales, and inland south from Duaringa and the Expedition Range of central Qld to Mt Kaputar near Narrabri on the north-eastern slopes of NSW (Fig. 15). It is nowhere common and there are few specimens in collections, with barely more than four dozen known, and these having mostly been hand collected, as the species appears not to be readily attracted to light.

Its resemblance to some of the other *Psaltoda* species (in song and morphology) may have accounted for it being overlooked. Its habit of resting high up on trees has ensured that voucher specimens for visual and auditory records are often difficult to obtain. However, in addition to the type series locations, reliable records do exist from Crystal Ck. in Paluma Range north-west of Townsville, Isla Gorge National Park near Theodore, Chinchilla, Noosa National Park, Lake Broadwater via Dalby, Upper Tallebudgera Ck. west of Burleigh Heads and Sundaun National Park near Texas in Queensland and Gibraltar Range west of Grafton in New South Wales. Song recordings have been obtained from some of these sites. It is puzzling why a species with a wide distribution and a diverse habitat preference should be in such low numbers in relation to the relative abundance of its close allies.

Acknowledgments

We thank Mr L.W. Popple for his considerable assistance with computer graphics, song analyses and statistical calculations, Mr S. Humphreys for photographs, Mr G. Daniels for editorial comment, Ms S. Beech for illustrations, Dr D.P.A. Sands for advice on statistical methodology and Mrs B.G. Moss and Mrs B.J. Moulds for typing. We also thank Professor A. Ewart and Dr M. Coombs for comments on the manuscript.

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